Verde Valley Gigabit Project Network Design & Roadmap

Phase One (Edited for Public Use)

Prepared for Verde Valley Regional Economic Organization

Proposal #111014

2/10/2015

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Executive Summary

VISION: One Gigabit per second for All

> *"We seek an integrated, Verde Valley-wide, phased network connecting and/or expanding providers' existing networks and adding new providers to meet demand. This network is key to the growth of sustainable economic development within the Verde Valley. Taking advantage of the open trench along State Route 260 and the designation of information as a utility, we anticipate the installation of conduit and fiber in the trench as an initial, key component to the build-out of the Verde Valley Network. We seek local community and provider collaborators willing to work together to accomplish this."*
>
> -Verde Valley Region Economic Organization Project Vision, Aug 14, 2014

The Verde Valley Regional Economic Organization (VVREO), consisting of representatives from the municipalities of Camp Verde, Clarkdale, Cottonwood, Jerome, Sedona and the Yavapai-Apache Nation, is well aware of the region's insufficient broadband connectivity for modern applications. Indeed, given the resources present, the Verde Valley can and will continue to flourish as a leading community for conducting business and raising a family provided that adequate bandwidth can be provided to area residents. As far back as April 2009, volunteers from the VVREO formed the Verde Valley Broadband Coalition to address this issue. Now, with the State's announcement that a segment of State Route 260 will soon be widened, the Coalition and VVREO see an irresistible opportunity to employ Senate Bill 1402 and have Ethernet Fiber placed in conduit along the newly rebuilt highway.

GSW Telecom & Consulting (GSW), a Tucson-based firm specializing in the feasibility, planning, design and engineering of Fiber-based telecommunication networks is cognizant of the opportunity to leverage a new high capacity fiber-optic network and serve the area populace of about 77,000. A 'future-proof' Regional Fiber Optic Network WAN could provide bandwidth to the communities in the Verde Valley with the stated goal of Gigabit capacity. Metropolitan Area Networks (MANs) could be designed and engineered to extend fiber connections to area government, education, commercial business and buildings, thereby linking Mission Critical services such as First Responders (Fire, Police, Ambulance) and municipal buildings (libraries, hospitals). Links for commercial and IT facilities demanding high capacity bandwidth could sensibly be constructed and connected in defined phases. In addition to utility-grade broadband supporting various commercial enterprises, Verde Valley residents could enjoy the benefits of high speed internet delivered to their doorsteps and an array of applications including streaming content (Netflix), distance learning, Telemedicine, Smart Meters, utility management and future applications.

GSW has developed a Technical Assessment and Gigabit Network Roadmap in Phases for the Verde Valley. Per the agreement, Phase One delivers a Conceptual Middle Mile Network Route originating in Camp Verde (Colocation Site) with splice points at key locations to the Yavapai-Apache Nation and connecting Cottonwood (along State Route 260) and SR 89A (E/W) to Clarkdale, Jerome and Sedona. Put simply, Phase One integrates the VVREO's Vision with GSW's development of a Fiber Middle Mile and Metro Area Network design.

In Phase Two, GSW will complete the second phase of Verde Valley's Middle Mile Fiber Route starting in Sedona's Colocation, then continuing along Route 179 South to the communities of Big Park/Village of Oak Creek, Beaver Creek, Rimrock and McGuireville, plus the Yavapai-Apache Nation's Cliff Castle Casino and additional key locations, ultimately completing and closing the Verde Valley Middle Mile Network ring in Camp Verde's Colocation facilities. It is important to note the Middle Mile network design includes planned network break out points for network vaults and splice points to ensure all communities along the route can be connected in the future (e.g. the Verde Villages, Bridgeport, Page Springs, Cornville, etc.)

In Phase Three, GSW will deliver a detailed Carrier inventory and routes of Primary and Secondary Fiber and Wireless Carrier Networks, Interconnection, Bandwidth, Route Diversity and Colocation options.

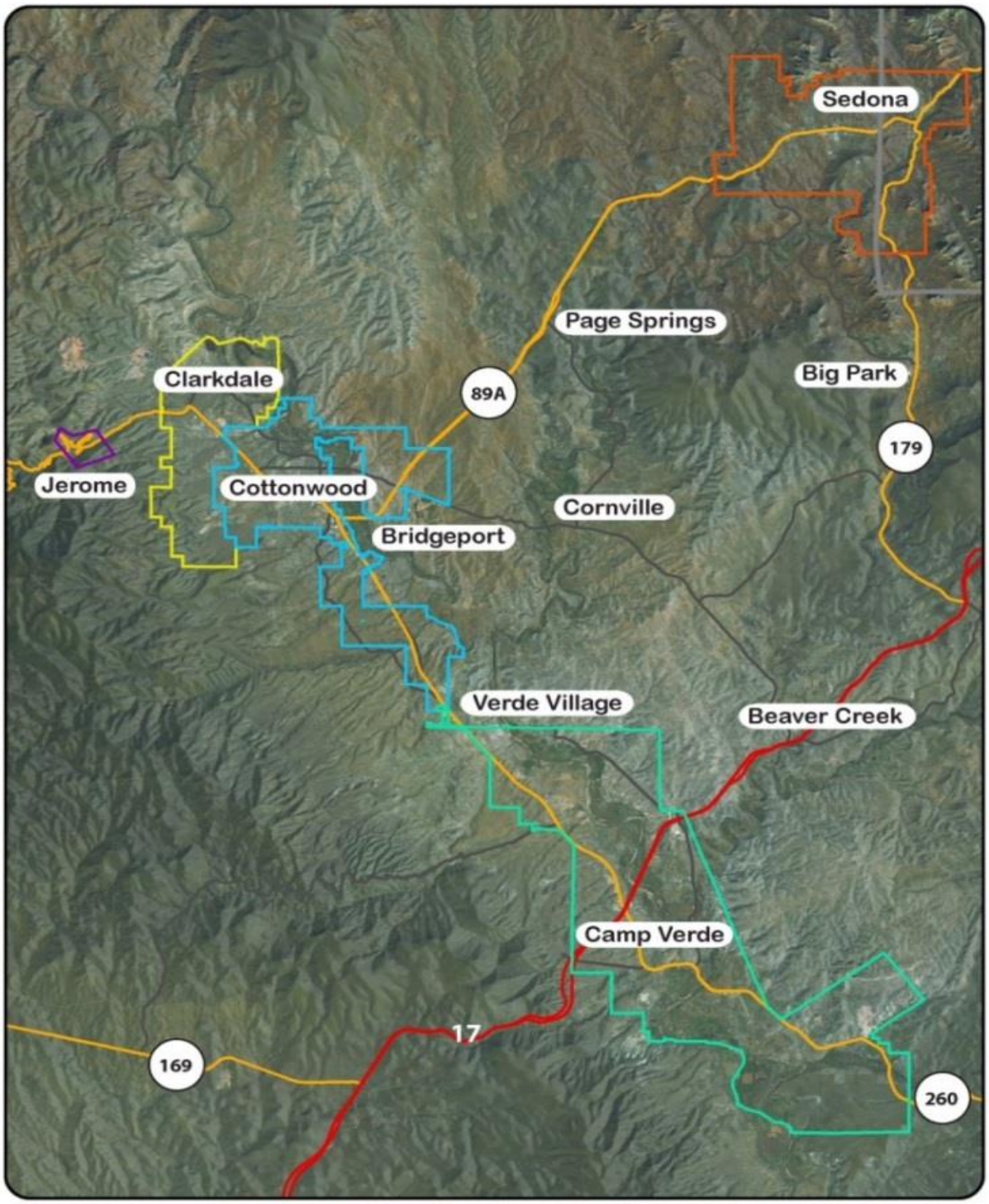
Introduction

GSW is pleased to present our research and findings in this document on the Technical Assessment of bringing a Gigabit Network to the Verde Valley. After months of specific investigation, interviews and enquiry, we feel that the timing for this project is excellent. The State of Arizona, even under the most conservative predictions, will continue to grow over the next few decades at an annual rate of 2% to 5%. Additionally, there's no question the communities of Verde Valley need a second Middle Mile carrier and Fiber or Wireless MANs (Metro Area Networks) to support their continued growth. While the backbone of the network will undoubtedly be Ethernet Fiber, recent advancements will provide the communities with the opportunity to utilize newer technological hybrid solutions. For example, in instances where fiber construction is cost-prohibitive to a home or small business, modern technology will permit the end users to have broadband connections wirelessly via hybrid configurations.

Success comes when preparation meets opportunity. The VVREO's determination to install a fiber-based network, combined with the areas' existing infrastructure (including Right-of-Ways (ROWs), substations, facilities, fiber optics, microwave, fixed wireless, tower & pole attachments), puts the Communities in a fantastic position to leverage such assets. While the impetus for this recent action is to take advantage of placing conduit in the ground as the Arizona Department of Transportation expands State Route 260, the reality is this network has been in the works for years. The new Network takes advantage not only of Senate Bill 1402 establishing information as a utility within Arizona, but will also bring new products (Internet, Transport & IP Phones, FTTT, FTTH with Hybrid Middle Mile and Last Mile Fiber, wireless & microwave, cable, networks) to the Verde Valley.

This document is best read in sections and has been divided as such. A page with definitions of some of the more common telecom terms is also included near the Works Cited page to help as well. It is designed to serve as a road map and guide and is based on documented research, comparing and contrasting options, verifiable references and GSW President Les Smith's 28+ years in the telecom industry, including his supervision of thousands of miles of fiber network expansion over of the course of his career. Andy Wieser, VP of Business Development, is also pleased to contribute in the writing and formulation of this document with his 15 years of finance and telecom experience. Our Vice President/Director of Network Engineering Chris Bradley, who brings nearly 30 years of experience in advanced Network Engineering, has added supporting technical design and documentation. As the report was being crafted, not all needed information was able to be obtained in a timely manner. Hence in those instances we made experienced assumptions. It is our expectation, this report can and should be adapted and amended as needed. Further, given the timing of this project and its intersection with the holidays, both GSW and VVREO anticipate minor adjustments will be made to accommodate the availability of additional information in early 2015. As such, GSW warrants reasonable adjustments to this report are already included in the Phase I invoice and will be completed at no additional cost. We welcome the chance to answer additional questions, present our findings in person as needed and thank you for the consulting opportunity.

Phase One: Verde Valley Network Design & Roadmap



Foundation of a Network Roadmap

What is the Middle Mile?

In the telecommunications industry, the Middle Mile is the segment of a telecommunications network that links a provider's core network to a local, or Metro Area Network ("MAN"). For this proposed Network, the Middle Mile Network segments (or Transit Networks) for Verde Valley would connect the communities of Camp Verde, Cottonwood, Clarkdale, Jerome, and Sedona Metro Area Network MANs.

Conceptual Middle Mile

Our proposed network designs demonstrate the construction route of the Verde Valley Middle Mile, and Metro Area Networks (MANs) in four communities (Camp Verde, Cottonwood, Clarkdale and Sedona) and a Fiber or hybrid microwave and wireless network into Jerome through a phased implementation. GSW has an established methodology, logical construction progression and financial feasibility plan based on the information we have gained through direct research, sound business practices and internal, external sources and community collaborations. However, as newer and more accurate information emerges, this Strategic "Road Map" can and should be adjusted as needed.

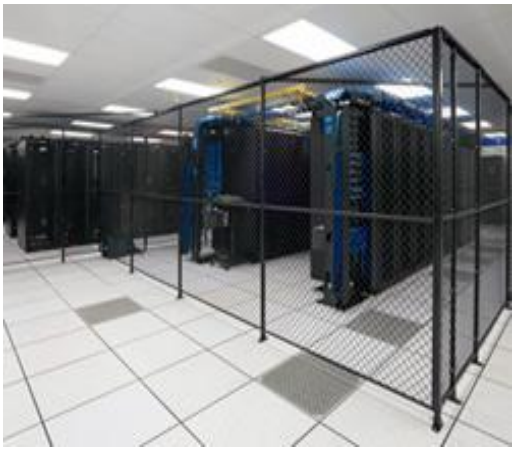
As illustrated in the accompanying diagram and explanation, the Middle Mile Network serving the Verde Valley will originate in Camp Verde due to its geographic location on State Road 260 and I-17. The Network will cross connect in close proximity to a planned Carrier Neutral CoLo Meet Me Point.

What is a Metropolitan Area Network?

A Metropolitan Area Network (MAN) is a high capacity Telecommunications network that ranges in size from a few city blocks to an entire urban area or rural community. In Verde Valley's case, each Community will have its own MAN, being linked together via the Middle Mile network and cross connected in defined community Colocation facilities.

What is a Colocation Facility "CoLo"?

A CoLo site is where telecom, data space and bandwidth offer a junction to cross connect with other networks, equipment and providers. Colocation facilities provide space, power, cooling and physical security for the server and storage and networking equipment of other firms and connect them to a variety of telecommunications and network service providers with a minimum of cost and complexity. CoLos can be located in commercial lease spaces, government, educations or site build facilities. It is in the CoLo that data traveling over the network may actually access the Internet. Additionally, CoLos may both



be owned and operated by a specific provider for their exclusive use or can also be "Carrier Neutral," allowing multiple providers to cross-connect.

Verde Valley Gigabit Network Roadmap

Phase One

As reviewed in the Executive Summary, GSW has developed a Technical Assessment and Gigabit Network Roadmap in Phases for Verde Valley. Per the agreement, Phase One delivers a Conceptual Middle Mile Network Route originating in Camp Verde (Colocation Site) and connecting Cottonwood (along State Route 260) and SR 89A (E/W) to Clarkdale, Jerome and Sedona. Put simply, Phase One integrates the VVREO's Vision with GSW's development of a Fiber Middle Mile and Metropolitan Area Network design.

Future Phase Two

In Phase Two, GSW will complete the second phase of Verde Valley's Middle Mile Fiber Route starting in Sedona's Colocation, then continuing along Route 179 South to the communities of Big Park/Village of Oak Creek, Beaver Creek, Rimrock and McGuireville and Yavapai-Apache Nation Casino and communities, ultimately completing and closing the Verde Valley Middle Mile Network ring in Camp Verde's Colocation facilities. It is important to note the Middle Mile network design includes planned network break out points for network vaults and splice points to ensure all communities along the route can be connected in the future (e.g. Bridgeport, Page Springs, Cornville, etc.)

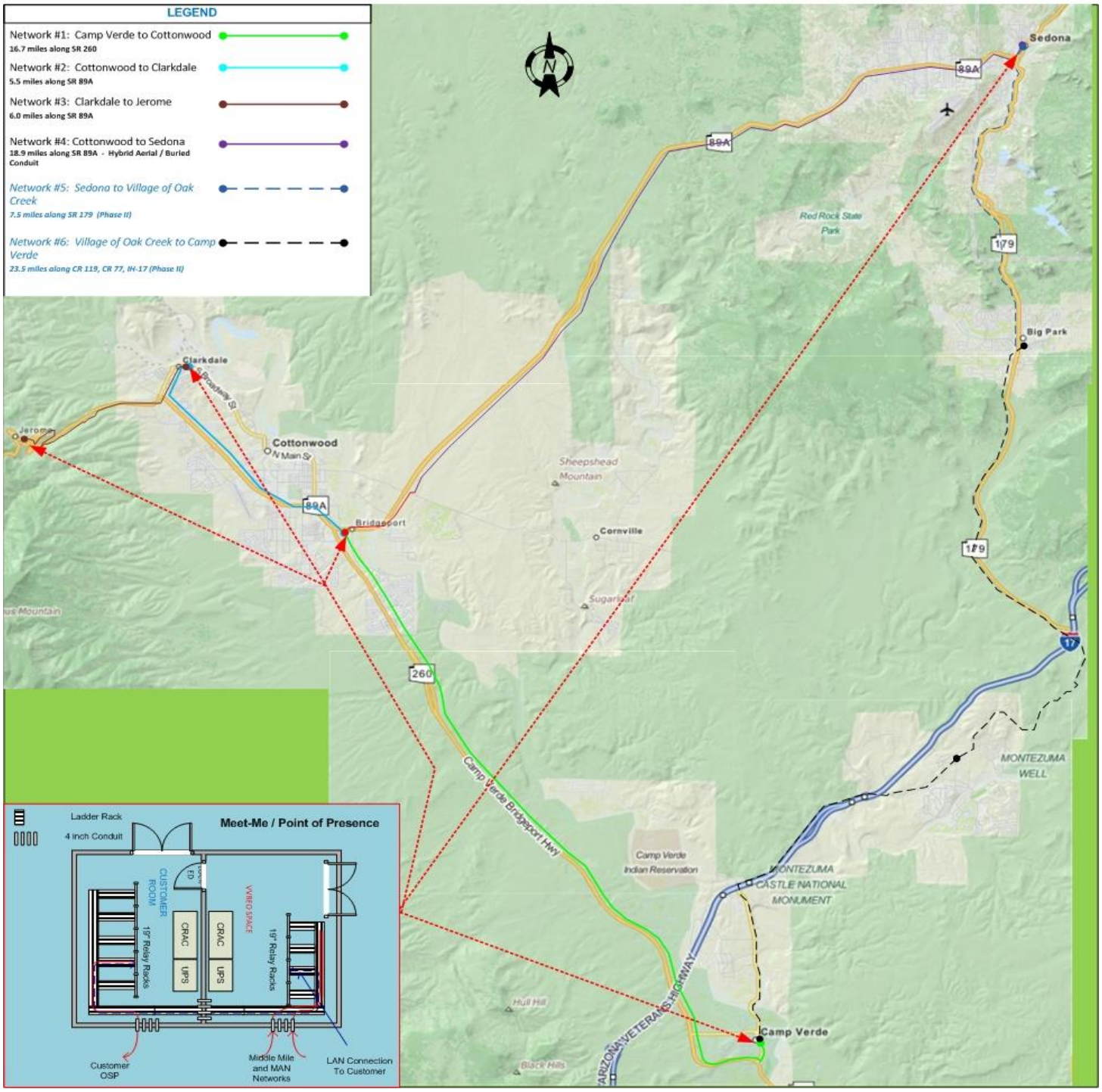
Future Phase Three

In Phase Three, GSW Telecom will deliver a detailed Middle Carrier inventory that includes routes of Primary and Secondary Fiber and Wireless Carrier Networks, Interconnection, Bandwidth, Internet Route Diversity and Colocation options.

Verde Valley Middle Mile Network Map

GSWTelecom
Voice, Data, Internet, Cloud IP, Consulting

Verde Valley Fiber Optic Project
Overall Map



Summary

Phase One Fiber Network Plan Summary

- **Middle Mile Fiber—**Build out Networks from:
  Camp Verde 16.7 miles to Cottonwood (SR 260), then to Clarkdale 5.5 miles along SR 89A
  Clarkdale to Jerome Spur route 6.0 miles along SR 89A
  Cottonwood to Sedona 18.9 miles along SR 89A
  Middle Mile Networks total estimate 47.1Miles

- **Metropolitan Area Networks—**MAN Build out
- **5 Colocations & Carrier Neutral Locations**
- **Conduit model** for VVREO communities and Yavapai County

- **Future Fiber to the Home** – Several Next Generation Services for residents would become available for homes connecting to the Fiber Optic Network.
  - **High Speed Internet Access –** speeds of 10Mbps - 1Gbps would be available
  - **Hosted IP Phones** – VoIP Telephone Services can be delivered over the network
  - **Cable Transport** – Most Cable Providers are seeking Fiber Optic Access to homes
  - **IPTV—**Television subscriptions over IP Network Services

Colocation (CoLo) and Cross-connecting Networks

As mentioned above, GSW Telecom has defined and designed five Carrier-Neutral Colocations across the network to serve the Verde Valley communities.

CoLos can also generate revenue. Area Business, Education and Government institutions may choose to move some or all of their servers and applications into a leased CoLo facility. Generally speaking, advantages of Colocation include cost savings, reduced capital outlay, redundant or blended internet bandwidth from multiple carriers, physical security and Backup and Disaster Recovery (BDR) support. Below is a reference point for the revenues CoLos can generate in a metro market. As there are variances in the different markets and based on demand and promotional pricing, the chart illustrates baseline pricing.

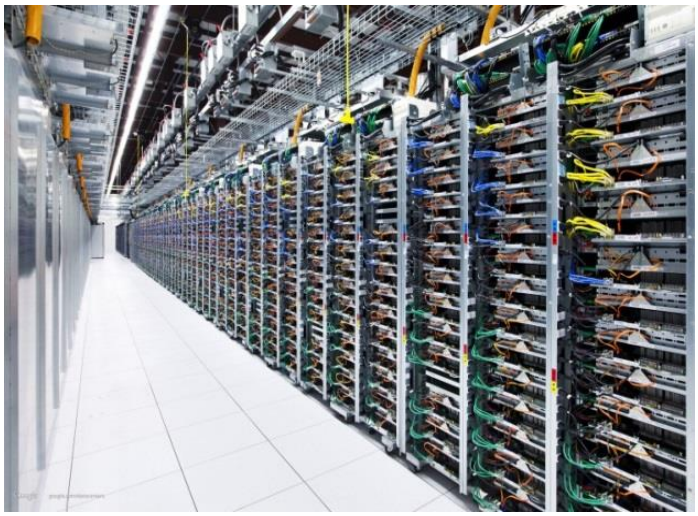
Data Center Backup, Backup and Disaster Recovery

While there are no national or Tier II/III Data Centers in Verde Valley, there may be a handful of small Government, Education and Public Safety Data Storage facilities that are not open to private businesses. These government, education and public safety data center facilities pose no competitive threat and are in fact, key target customers for wholesale bandwidth and Backup and Disaster Recovery (BDR) solutions. It is also believed that area Internet Service Providers (ISPs), while limited in their size and footprints, would benefit with potential expansion and reliability as fiber is built out in each community as has been the case in Tucson and Phoenix. Additional ISP details are covered in each of the market analyses towards the end of the report.

The modest requirements of a CoLo contrast with that of a Data Center, which is a much larger facility used to house computer systems and associated components such as telecommunications and storage systems. Data Centers generally include redundant or backup power supplies, redundant data communications connections, environmental controls (i.e., air conditioning, fire suppression) and security devices. Large data centers are industrial scale operations using megawatts of electricity annually. While there are dozens of data centers throughout Arizona, it is important to consider that before any thought is given to building another one in the Verde Valley, any national carriers (i.e. CenturyLink, Zayo and Level 3) are located on national fiber backbones with access to 300+ data centers around the country with literally millions of square feet of leasable space. According to Gartner Analyst John Morency, as Cloud Services continue to develop and evolve, their impact on Data Centers will be dramatic.

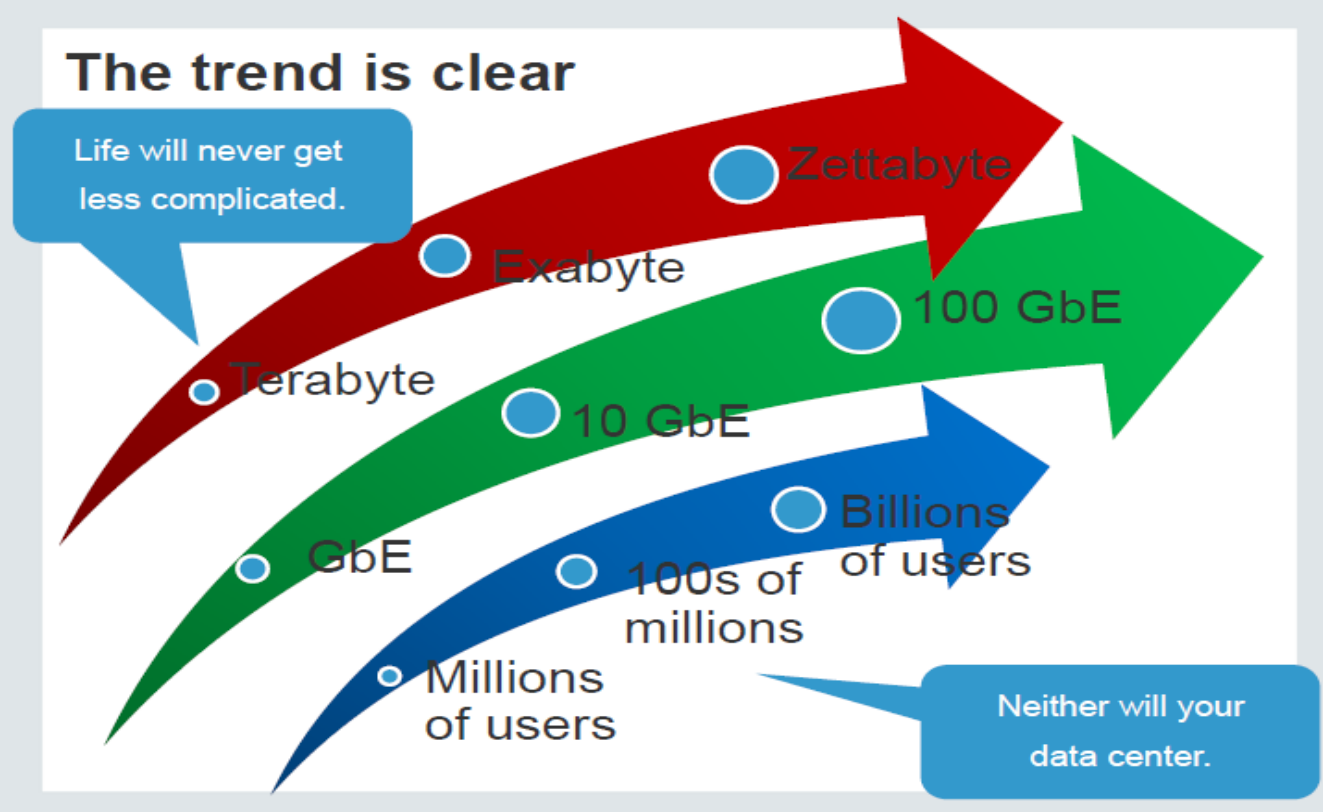
> *"Cloud services are changing data centers. Migrating production workloads to the cloud may not be considered viable for you today. However, as the market evolves, we expect service providers to continually improve the type and viability of their services and the maturity of their operations, as well as enhance security and service-level offerings. If in five years the market has evolved as Gartner expects, it would not be uncommon to see many organizations offloading nonessential work to specialty providers and keeping mission-critical or highly sensitive applications in-house."*

Morency also tackled the question of how big Data Centers need to be in order to support future capacity and growth demands.



"[A]ssume whatever floor size you design was created to allow full use of [40 rack spaces] without the fear of hot spots (and there are many ways to do this without a great deal of expense). Taking the same 40 racks, if pushed to 90% capacity on average (leaving some room for switches, etc.) and upgrading the existing server base over the next two years to 1U [equipment designed to mount in a 19-inch rack or a 23-inch rack] servers, the data center would support 1,520 physical servers. Therefore, a data center server area of the exact same size, containing 40 racks and using the proper design, would support 15% growth every year for at least eight more years. Now the question becomes, do we build it bigger to support the original target of 2,000 servers, or will a future technology refresh within the next eight years double our capacity yet again? The logic works with servers as well as storage, as each device category continues to decrease in size, improve in capacity and performance, and reduce the power consumption per unit of work with each new generation. If we were to look at these performance and density trends and make the assumption that the curve will continue, even at a much slower pace, it becomes clear that even small data center environments can have significant growth rates (well more than 20% CAGR), while maintaining the exact same footprint over the next 15 to 20 years."

(Morency, 2013)



Morency even addresses the environmentally friendly possibilities of Data Centers.

> *The focus on green is becoming a dominant trend in design today, but in most cases, it is not about using the newest technologies to be seen as environmentally friendly. Instead, it's about using technology efficiently to reduce operating costs, with a value-added benefit of becoming more environmentally friendly. This becomes the rare win/win/win situation where IT reduces day-to-day operating expenses, corporate social responsibility is enhanced, and the end result helps the environment. Practical things can be done to create more-efficient designs (e.g., using outside air, water-side economizers and designing liquid cooling into the site), and there are also many design techniques that focus on the overall building's impact on the environment (e.g., Leadership in Energy and Environmental Design [LEED] certifications, types of building materials, renewable energy alternatives, site selection and water conservation techniques).*

In the Appendix, GSW has also included a brief write up of ongoing solar and wind projects in Arizona. Though there are none in the immediate area of Verde Valley, if a project were to commence in the future, interconnectivity to the Verde Valley network would be a benefit to the developer.

Best Practice for Economic Development and Workforce Retention

There's little question that completing Middle Mile and Colocation facilities in each of the communities could enable an enterprise zone model for the Verde Valley to attract business and economic development. For the Verde Valley to continue to attract new corporations and large scale technology industries there must be a streamlined and replicable process in place to make it attractive to move there. Such a plan expedites land acquisition, zoning, approvals and solutions for power and telecom questions (including a minimum of two separate and diverse bandwidth providers) among other things.

Growth and Revenue Impacts

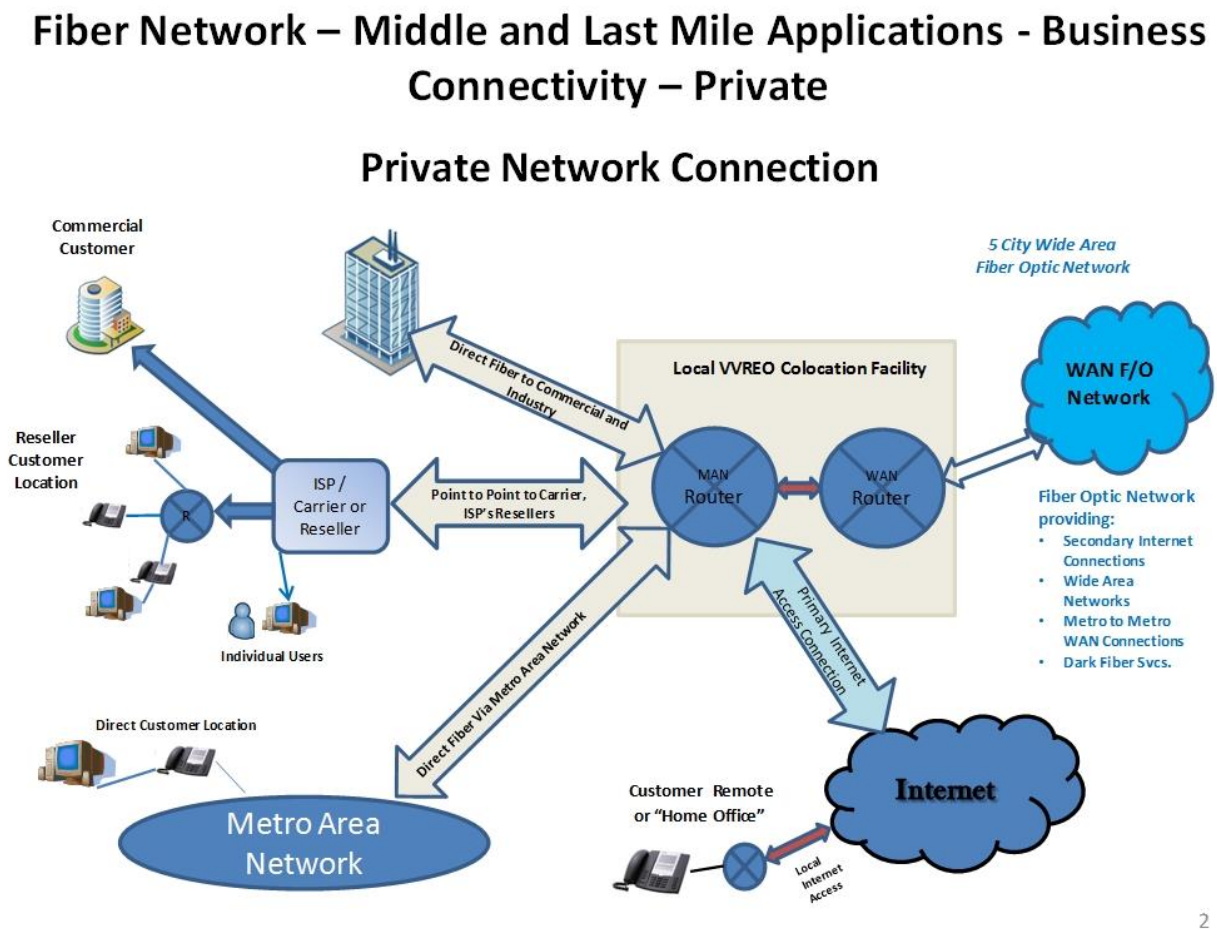
There is significant evidence that shows a robust telecommunication network is an engine for growth and employment. With regard to positive public relations, consider Google's decision to select Kansas City (both Kansas and Missouri) as the first city in the country to be a 'Gigabit City' where Fiber to the Home (FTTH) would be deployed. A key reason Google selected the city was because of the city's promises to minimize red tape with regard to providing ready access to easements, rights of way, expedited permitting and assistance with public relations and marketing. However, in spite of these promises of cooperation, the initial deployment was hampered and delayed by pole attachment rates and the physical placement of the lines.

The benefit to having the members of the Verde Valley Regional Economic Organization lead as champions of a network means that cooperation between local government and businesses is virtually assured in the majority of situations and thus avoiding delays. The members of the VVREO should pride themselves on being forward thinking champions and instrumental to the implementation of a highly reliable network to an underserved rural community in Arizona. Indeed, as mentioned above, VVREO should embrace this role and leverage it to try and bring new businesses to the area.

(Kandutsch, 2013)

Verde Valley Community Metropolitan Area Networks (MAN)

A Metropolitan Area Network (MAN) is a high capacity Telecommunications network that ranges in size from a few city blocks to an entire urban area or rural community. In the Verde Valley's case, each community will have its own MAN, being linked together via the Middle Mile network and cross connected in defined community Colocation facilities.



Current Connectivity Options in the Five Communities

A few years ago the Arizona Strategic Enterprise Technology (ASET) office, a division of the Arizona Department of Administration (ADOA), created the Digital Arizona Program with a stated goal of supporting "Internet providers, communities, and educators coming together to create solutions and to support an ever increasing demand for high-speed Internet capacity throughout the State." Among the features of the website is an interactive map (http://broadbandmap.az.gov/map/) which allows a user to select an area of their choice and identify providers serve the specified area. While this list is not definitive, it is directional and serves as a reference point. The Verde Valley has a limited number of options for broadband, and as illustrated in the Appendix ("Current Broadband Options in Verde Valley"), speeds are very constrained by the existing network. While it may seem there are many choices for Broadband connectivity, upon further examination, they are largely just variations of fixed, wireless-, DSL based-, satellite-, and cable-based services, all of which, (we believe, with the exception of the expensive satellite-based service) tie back to CenturyLink's main backbone.

(State of Arizona, 2014)

Carrier Inventory

The chart below is a graphical representation of the terrestrial (non-satellite) carriers providing services in the Verde Valley. A more detailed inventory of each carrier's options in each of the Five Communities may be found in the Appendix.

	Sprint	Verizon	Commspeed	Suddenlink	CenturyLink	CableOne	eSedona	T-Mobile	ATT
Camp Verde	X	X	X	X	X				X
Cottonwood	X	X	X	X	X	X		X	X
Clarkdale	X	X	X		X	X	X		X
Sedona	X	X	X	X	X		X	X	X
Jerome	X	X	X		X	X	X	X	X

GovNET's Wireless Gigabit network construction schedules and locations are currently not available. GSW in fact requested this information several times but at this time have yet to receive any written documentations. Once we receive the details they will be listed in the appendix for future reference.

We have had several positive conversations with Suddenlink and other carriers and service providers that require additional follow up and collaboration on network routes for further refinement of the data.

The illustration on the following page, "Technologies and Speeds: Fiber Ahead of All Others," is very telling. The red ovals to the left are the technologies that are mature and are on the lower end of the bandwidth spectrum and are where the Five Communities lie presently. These ovals represent

bandwidths that are primarily less than 10 Mbps (Best effort) and only one (Cable Modem) even approaches more than 50 Mbps.

However, when Fiber Optics (labeled as “Fiber to the Premises”) is considered, the large blue oval at the top dwarfs every other method of connectivity. Speeds of 1 gigabit per second, about 10,000 times faster than old fashioned Dial Up, are now achievable. And unlike the quality that Fiber can provide, only a fraction of the current options offer ‘synchronous’ or ‘symmetrical’ speeds, where the up- and download speeds are the same. Fiber-based symmetry is crucial for applications such as videoconferencing, gaming, Skyping and Cloud-based Applications-as-a-Service (AaaS) as bandwidth demands increase.

Technologies and Speeds: Fiber Ahead of All Others illustration

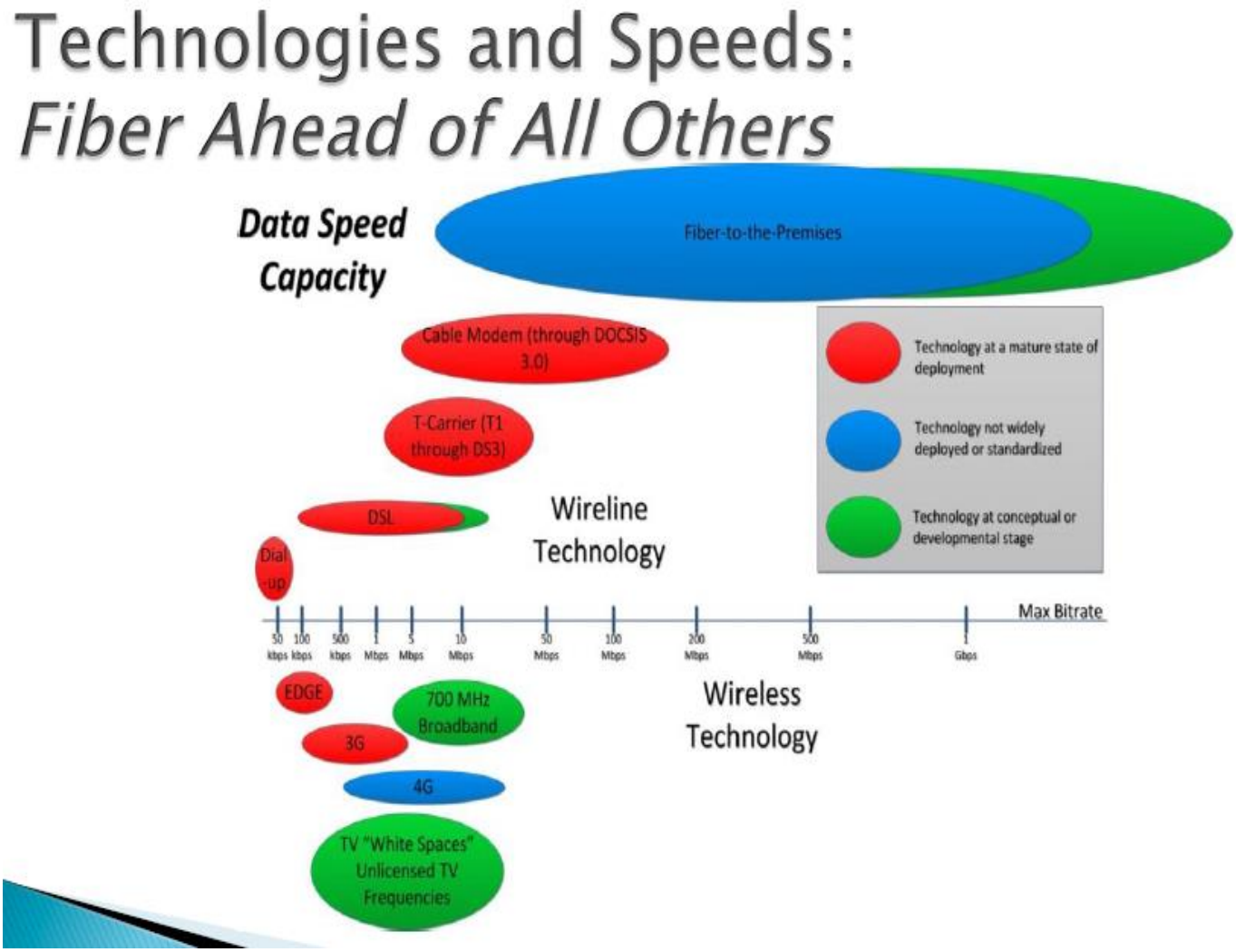


Image Courtesy of CTC Technology

As a last and final illustration of how crucial connectivity has become in today's modern world, consider that a digitized movie might be about a 2 Gigabit worth of data, and a HD version of the same film might be triple that. When the estimated advertised, best effort download speeds for today's Verde Valley are evaluated and compared to what is required to watch a film, it is little wonder that only those with cable modems might be even inclined to try and download a film. However, the point of the VVREO Network is not necessarily to make sure that area residents can utilize Netflix, but rather to show that compared to Tucson and Phoenix, area Verde Valley businesses are currently relegated to one of the lowest bandwidth and quality of service (QoS) standards in the state. While it may be annoying to have to wait for a few hours for a movie to download on a T1 connection, what the financial implications for engineering firms that have to wait hours for CAD files? Or what are the implications for a patient that must wait for a scan to download in order for a physician to make a proper diagnosis? Under these circumstances, when millions of dollars of commerce and contracts, as well as potential (and literal) life-or-death decisions may rely on connectivity, the need for a quality network is undeniable.

Minimum Times for Downloading and Uploading a 5 GB illustration

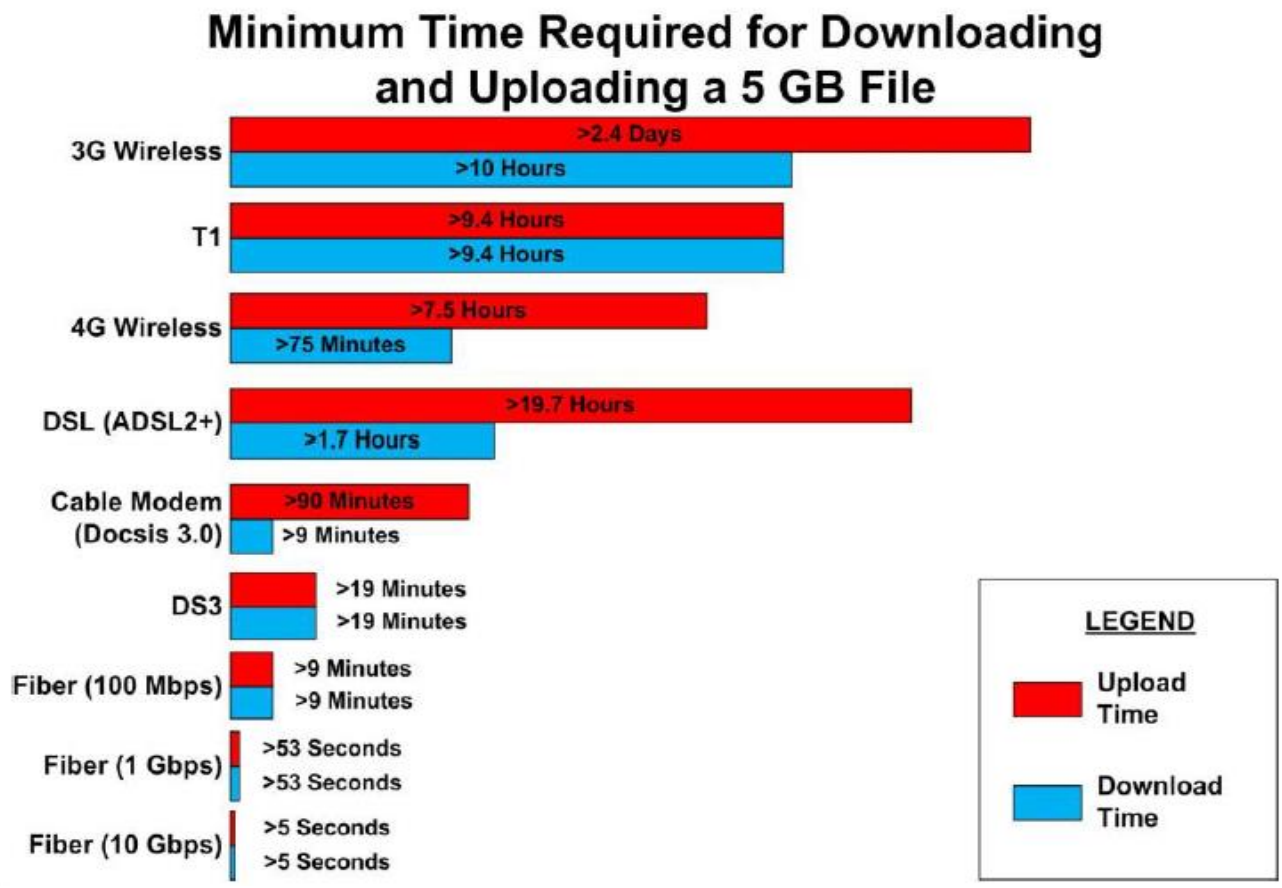


Image Courtesy of CTC Technology

Competitive Analysis – Broadband

The accompanying ad is a sample of the types of broadband being offered in Verde Valley. At first glance to the uninformed consumer, 15 Mbps for $35 would seem like a reasonable deal and meet or exceed current FCC Broadband minimum requirements. However, when the details are examined, one finds that speeds vary and are not guaranteed, unlike the QoS (Quality of service) that fiber provides. Also, it is not disclosed what the upload speeds are and suggesting Best Effort.

Upon digging a bit deeper into the provider's website, it's revealed that the 15 Mbps speeds (at best) are also just 1.5 Mbps (best effort) upload, a 10:1 differential. Likewise, the other speeds are 30/2 (a 15:1 differential), 50/3 (16.667:1 differential and finally the 100/5 (20:1 differential!)

To draw an analogy, consider a highway that permits traffic to flow at 60 mph in one direction and anywhere from 3 to 10 mph in the other direction to see how much the connectivity disparity truly is.

Faster Internet	15 Mbps Download 1.5 Mbps Upload	30 Mbps Download 2 Mbps Upload	50 Mbps Download 3 Mbps Upload	100 Mbps Download 5 Mbps Upload
Great for browsing, email and staying connected	✓	✓	✓	✓
Great for streaming TV shows and movies		✓	✓	✓
Great for gaming, and enough bandwidth to power all of your devices			✓	✓
Fastest speeds available!				✓

Verde Valley Gigabit Project – Middle Mile (Transit Fiber Routes)

There are five main communities included in the scope of this project:

- Camp Verde
- Clarkdale
- Cottonwood
- Jerome
- Sedona

Internetwork Connectivity for Middle Mile to local Metropolitan Area Networks (MAN) for each community will be designated in Phase Two of this project. However, for purposes of this scope, we are utilizing either the Town Hall of that community or another Municipal Facility that is located in the area where the interconnection of the Middle Mile Transit WAN (Wide Area Network) and the Local Area Metropolitan Area Network would best intersect for cross connectivity.

The Middle Mile or Transit Wide Area Network will travel along major roads and highways where possible in order to reduce overall costing through availability of access of equipment needed to install the fiber optic cabling. Both existing fiber routes owned by carriers and other providers, as well as new-build fiber optic cabling, are being considered for the development of the designed networks.

Primary and Secondary IP Services carriers are being identified for possible provisioning of outside Internet Protocol Services for the VVREO Network and participating customers. These services would include Internet Access Services, IP Telephony Solutions including Hosted IP Telephone Services, Hosted IP PBX Services, Disaster Recovery Solutions, and Cloud Computing Services. All of these types of services would be delivered over the VVREO WAN via interconnections at any of the proposed Points of Presences (POPs) and Meet Me Colocation (CoLo) facility sites.

Considering most major carriers in the area have networks traveling alongside Interstate 17 (I-17), the Camp Verde CoLo/POP would be the logical primary Interconnection site for the entire network. There are other secondary carriers in the region that have networks near or within the Prescott Valley area, as well as alongside State Route 89A. These carriers could be interconnected to the network at either Sedona or Jerome and then distributed to the entire network.

The proposed network is being designed based on an Ethernet-type network utilizing both Layer 2 and Layer 3 distribution and routing for data connectivity. Layer 2 and Layer 3 methods are in accordance with the International Standards Organization's OSI Model for networking. Ethernet is a Data Link Control method from the IEEE (International Electrical and Electronic Engineers) which establishes the standards in data communications.

The Middle Mile (WAN) Network will originate in Camp Verde and travel via State Route 260 to Cottonwood. From there, it will junction to Clarkdale via Main Street and then transit to Jerome from

Clarkdale via State Route 89A (SR 89A). The last leg of the WAN will be from Cottonwood to Sedona via SR 89A. Effectively, the Cottonwood CoLo/POP will become the junction for all legs of the Middle Mile WAN Network.

The initial four Middle Mile Networks are as follows

Network #1	Camp Verde to Cottonwood	(Approximately 16.7 miles)
Network #2	Cottonwood to Clarkdale	(Approximately 5.5 miles)
Network #3	Clarkdale to Jerome	(Approximately 6.0 miles)
Network #4	Cottonwood to Sedona	(Approximately 18.9 miles)
	Total Network Distance:	**Approximately 47.1 miles**

In a future Phase of this project, it is recommended to add another three legs to the Network that would travel from Sedona to the Village of Oak Creek, then from Oak Creek terminating in the Rimrock area at Beaver Creek School where a Manufactured Building (POP) would be placed. From that location, the last leg for this Middle Mile WAN would continue southwest to the Camp Verde POP where the Wide Area Network originates. This would provide a full ring format that would allow bi-directional routing, as well as high availability route services to maintain connectivity in the event of a catastrophic fiber failure from a variety of possible causes.

Facility Equipment Based on Locations

Hub Facilities - At these colocation facilities, we may inject connections to the third party service providers such as Internet Services, IPBX services, as well as any other services VVREO may wish to deliver to their customers.

Central Office (CO) Facilities – At these locations we can cross connect to both Telecommunication Carriers, as well as Internet Service Providers currently collocated at those facilities. Both ONS Multiplexers as well as IP routers would be deployed at these facilities for internetwork connections.

Colocation Facilities – ISPs as well as other Internet Based Service Companies have “Meet Me” facilities at these locations. Also, VVREO and or a Strategic Partner may lease space for Hosts and Storage Equipment to provide various services such as Disaster Recovery Facilities, Backup Facilities, and Hosted Application Services. IP Routers would be the primary type of equipment placed within these facilities for internetworking with the providers at these facilities.

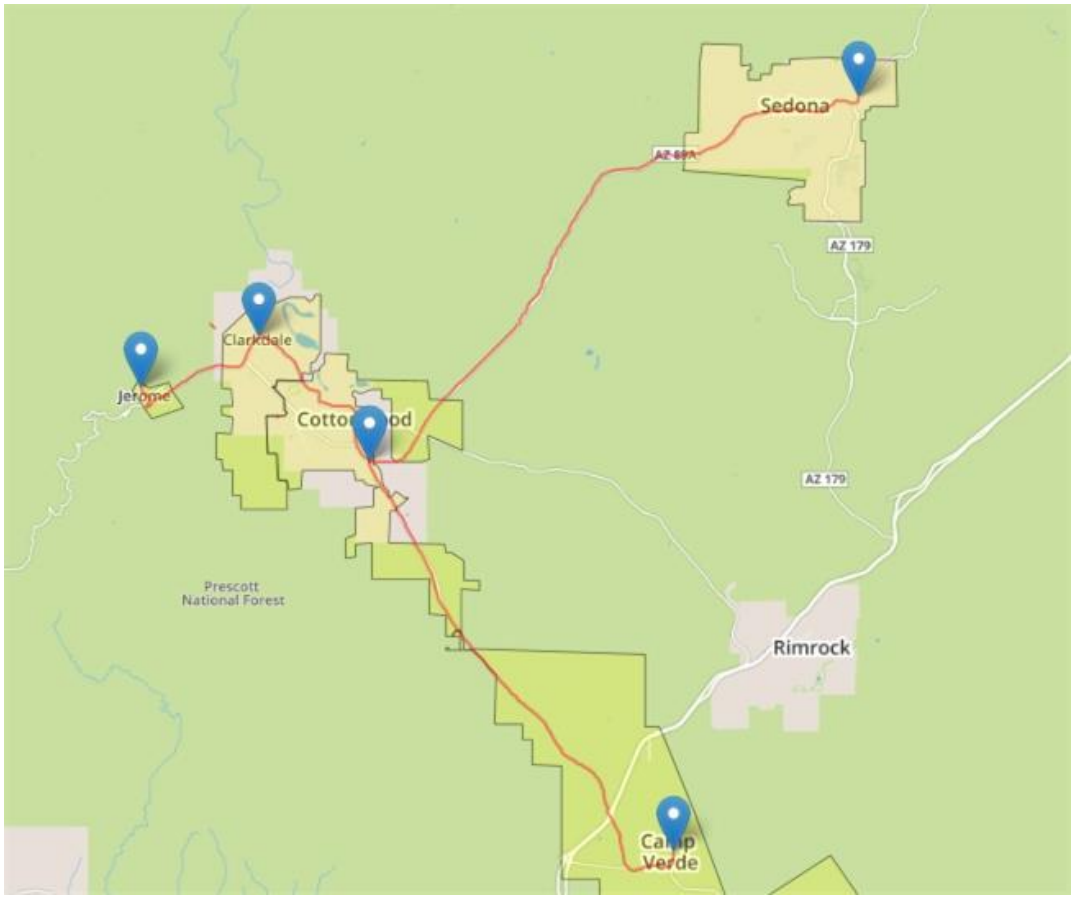
Core Network Services – These services should be based in VVREO-owned facilities for security and control purposes. Edge Networking is where VVREO and or a Strategic Partner would connect to customers at the colocation and Meet Me Points. IP routers such as the Cisco 7600 Series Router would be a suitable framework for conducting Edge/Access Network Services.

NOC – The Network Operations Center is where all monitoring and management services and processes will take place. The NOC will require several types of tools, equipment, storage, applications and a trained staff to monitor the network on a 24x7 basis.

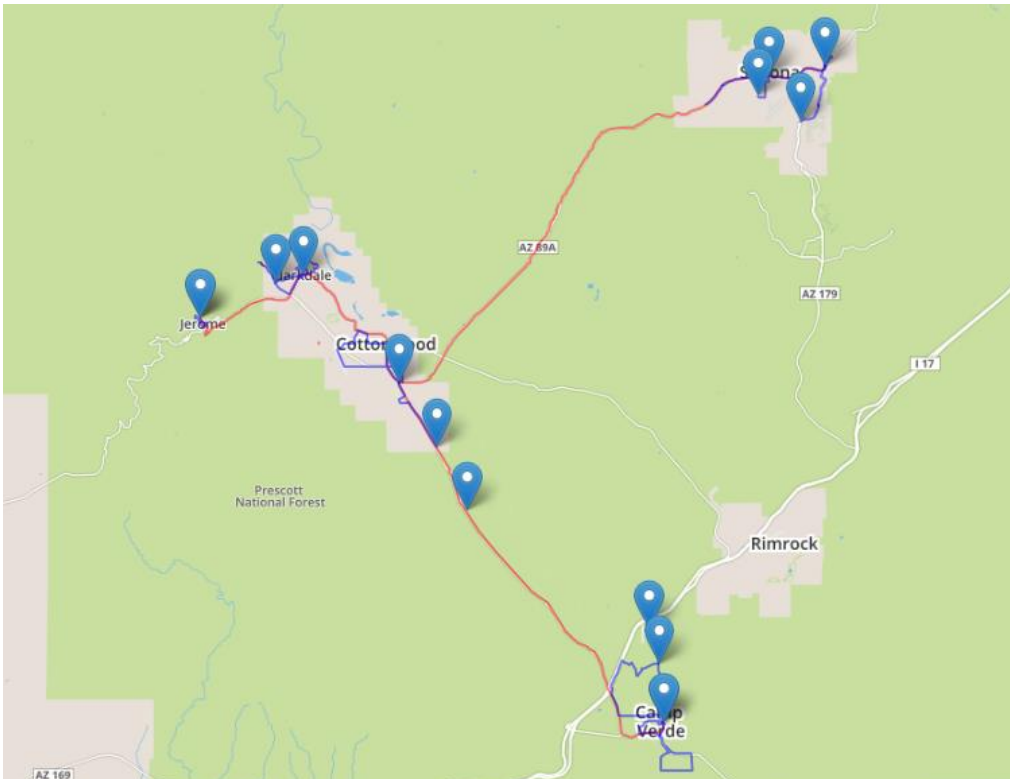
Service tickets/Help Desk – This is an extension of the NOC that will field the calls and requests and deliver Tier I level of services to diagnose and possible resolution to any customer or operational issues that may arise. There are several Service Ticket Applications on the market that can be modified to meet the specific needs for the VVREO Network Services.

Overall Middle Mile Initial Network

The diagram below depicts the route paths for the fiber optic cabling (in red) and the proposed locations of the metropolitan area Points of Presence / Colocation Facilities.



The Diagram below depicts the overall network with the POPs, MANs, and Proposed Splice Vaults for the VVREO Network.



Ultimately, to get high capacity, reliable, cost effective bandwidth, there are three progressions. First, a Middle Mile network must be constructed. This Middle Mile delivers outside services bandwidth to the MAN. The MAN is then able to be extended and deliver services to residential and or business areas. The method of delivery may be in any number of ways, including Fiber-to-the-Home, Wireless, Copper Ethernet/DSL or even Coaxial cable. Due to the expense of retrofitting existing homes with fiber or wireless options, there is a strong case to be made for planning for this with any new homes and developments. As might be expected, new home developments can assist tremendously by putting additional conduit throughout the subdivision. Much like SB 1402, there is a section in the document dedicated solely to this topic as well.

Fiber Optic Cabling Type Since most of the Metropolitan Area Networks are Hybrid installations (Aerial and Buried), it is recommended that Aerial Fiber Optic Cabling be utilized for both methods of the aerial and underground installation. This will have an added benefit of reducing overall costs through using one type of cabling throughout the construction project.

Camp Verde

The Town of Camp Verde lies along the junction of Arizona State Route 260 and Interstate 17. Unlike the other four municipalities of Cottonwood, Clarkdale, Jerome and Sedona, Camp Verde lies to the east of the Interstate. Like most communities in Yavapai County, the town has seen a near tripling of its population since 1980, when the population was under 4,000. Just 34 years later, Camp Verde now numbers over 11,000. The Camp Verde Unified School District serves the area.

With regard to notable establishments near the town, visitors can visit Montezuma Castle National Monument, Historic Fort Verde State Park, Out of Africa Wildlife Park and Cliff Castle Casino, an enterprise of the local Yavapai-Apache Nation.

(City of Camp Verde, 2014)

Cottonwood

Approximately 16 miles to the northwest of Camp Verde along Arizona's State Route 260 (SR 260) is the City of Cottonwood. As previously discussed, the first 7.7 miles or so of this highway are being widened and re-engineered by the Arizona Department of Transportation in 2015. It is in Cottonwood that SR 260 has its terminus, meeting Arizona's State Route 89A (SR 89A), which runs from the Yavapai County Seat of Prescott through Prescott Valley to Jerome, Clarkdale and Cottonwood, and then proceeding through to Sedona and ending in the Coconino County Seat of Flagstaff.

Cottonwood's current population is approximately 11,500, up from about 4,500 in 1980. The unincorporated communities of Verde Villages and Bridgeport are also in the greater metro area, though separate and distinct from Cottonwood. However, when including those populations, the immediate area numbers nearly 25,000. Cottonwood's children are served by the Cottonwood-Village

of Oak Creek School District and the Verde Valley Medical Center serves as a significant resource in the area.

(City of Cottonwood, 2014)

Clarkdale

Founded by copper magnate William A. Clark in 1912 as a smelter town for the nearby mines in Jerome, Clarkdale is an early example of a 'company town' for employees and operations. After the mine's closure in 1953, a period of hardship occurred, but today the town has rebounded to become a flourishing retirement community with a focus on sustainability and outdoor recreation while leveraging its history to promote tourism and the arts. Clarkdale is about four miles from Cottonwood on SR 89A, though the town center ("Upper Clarkdale") lies about three quarters of a mile from the highway on Clarkdale Parkway.

The Town of Clarkdale has a population of just over 4,000 and school children attend the Clarkdale-Jerome School, the only school in the district of the same name. With regard to industry, there are several mining-related businesses (cement/concrete) and precision machine shops in the town. Artists abound and are featured through Made in Clarkdale, a local non-profit. Another popular Clarkdale draw is the Verde Canyon Railroad, a sightseeing train hosting about 90,000 visitors annually. In recent years with the development of the wine industry in the Verde Valley, Clarkdale has experienced growth in wine tasting rooms in addition to the development of the Southwest Wine Center, a center focused on wine production in arid regions. This new center is located at the Yavapai College, Verde Campus, also located in Clarkdale.

(Town of Clarkdale, 2014)

Jerome

Like its neighbor down the mountain, Jerome got its start as a mining town to house the men working some of the richest copper, gold and silver strikes ever discovered at any recorded time. During the mine's heyday in the 1920s, Jerome was home to over 10,000 people. Due to a combination of poor (but common at the time) mining and extraction processes resulting in subsidence issues and a decline in metal prices, the decision was made to close the mine in 1953. With little work, the community was in danger of becoming a ghost town. However, a successful push to have the entire town being declared National Historic Landmark Status, which was granted in 1967 led to a continued existence. Despite this, the population in 2010 was 444 and Jerome exists largely today as a tourist destination and art colony. As mentioned above, State SR 89A passes through Jerome on its way from Prescott Valley (to the west) to Clarkdale, Cottonwood and Sedona to the east. Likewise, the school children attend elementary school in Clarkdale and Mingus Union High School in Cottonwood.

(Town of Jerome, 2014)

Sedona

The City of Sedona, straddling Coconino and Yavapai Counties, is famous for its red sandstone formations. With a population numbering over 10,000 and an average household income of about twice of most of the other area communities (see chart in the demographics section of the document), Sedona's environs have led it to become a mecca for those wishing to hike, bike and experience the area's red rocks. The community has also developed a reputation as a place to seek metaphysical and spiritual energies and as a result of these factors, is home to almost 75% (3,000 out of 4,000) of hotel and resort rooms in the Verde Valley (see Table 3 below in Demographics.) Tourism and the related industries are undoubtedly the driving force in the economy.

Lying at the junction of State Road 89A (on its way from Cottonwood to Flagstaff) and State Road 179, which travels south and bisects the Village of Village of Oak Creek back to Interstate 17, Sedona's school

children are part of the Sedona-Village of Oak Creek Unified School District, which operates three schools.

(City of Sedona, 2014)

Positive PR

In addition to providing a much needed second provider of service to facilitate the growth of commerce and provide a competitor to the incumbent LEC and ISPs, the new network's diverse path will also allow government, educational enterprises and businesses to have a legitimate Backup and Disaster Recovery and Business Continuity Plan (BDR/BC) Plan. Such strategies to maintain mission critical applications require services from more than one carrier. Local schools and offices should be able to get many times their current bandwidth for a marginal increase in their budgets.

Moreover, the tale of the railroad and the fates of towns that were connected and those that were bypassed must be considered. Currently, the sentiment is that Phoenix and Tucson are thriving in part due being on the 'modern railroad' of high capacity broadband and growing as a direct result of having significant broadband options. Other towns, like those bypassed a century or more ago, are being left further and further behind. Younger residents of smaller, poorly-connected communities are not returning after university graduation partly because of a lack of broadband connectivity. Modern businesses and communities view high bandwidth as crucial to their future growth and in some cases, the difference between flourishing and withering over the next few decades.

Facility Equipment Based on Locations

Hub Facilities — At these Colocation facilities, we may inject connections to the third party service providers such as Internet Services, IPBX services, as well as any other services a provider may wish to deliver to their customers.

Central Office (CO) Facilities – At these locations we can cross connect to both Telecommunication Carriers, as well as Internet Service Providers currently collocated at those facilities. Both ONS Multiplexers as well as IP routers would be deployed at these facilities for internetwork connections.

Colocation Facilities – ISPs as well as other Internet-Based Service Companies have "Meet Me" facilities at these locations. Also, space may be available for hosts and storage equipment to provide various services such as disaster recovery facilities, backup facilities, and hosted application services. IP routers would be the primary type of equipment placed within these facilities for internetworking with the providers at these facilities.

Explanation of the benefit of installing empty conduit along roads

About a year and a half ago, the principals of GSW authored an article that was published in the July, 2013 issue of Trend Report, a monthly, Tucson-based publication focused on real estate trends, new developments and general information about the industry. In the article, which is reprinted in the appendix, we describe how simple 4" PVC conduit, costing pennies per foot, can save tens of thousands of dollars later if the decision to lay fiber is made. In addition to the later savings, it should also be noted that many times after a road or intersection has been widened, redesigned or repaved, there is a five year moratorium on cutting the new payment, thus essentially aborting the project even if the funds are made available.

Best Practice for Conduit and Local Road/Intersection Construction

From a legislative view, GSW recommends Yavapai County and the communities of the Verde Valley enact regulations that literally require the placing of at least two 4" conduits along any roads or intersections under construction, redesign or otherwise accessible. Les Smith, founder of GSW Telecom & Consulting worked for years with representatives from Pima County as GM/VP of TW Telecom on this very subject. While some in Pima County initially saw the value of placing empty conduit, others were skeptical, fearing that doing so could somehow be viewed as favoring one telecom firm over another. To avoid any illusion or suggestion of impropriety or favoritism, eventually Les was able to convince Pima County to charge the exact rate that the LEC (Qwest/CenturyLink) was charging for leasing conduit space out. This rate of $0.36 per foot per annum neutralized any idea of favoritism and is now enshrined in Pima County statutes when road construction is ongoing. This concept is very similar to Senate Bill 1402 (discussed below), but with the major difference that the state's bill requires telecom firms to agree in advance to lease the space. GSW recommends Yavapai County and the communities of Verde Valley account for the pennies-per-foot charge of the conduit in any case with the assumption that it will eventually be utilized regardless.

Explanation of the value of trenching with new Housing Developments

Similar to the value of placing conduit along new roads, GSW recommends any new housing developments require the developer to run at least one 4" conduit to each new home site. Although wireless technologies do exist that will allow current homeowners to take advantage of connectivity options not available years ago, in terms of being able to deliver bandwidth to a consumer's home, there is no superior medium than fiber optics.

Fiber-to-the-Home, also known in various circles as Fiber-to-the-Premises (FTTP) or Fiber-to-the-Building (FTTB) is the newest technology. In the past, fiber optics might be brought to a local connection point, where copper cables would then connect homes and businesses. While this is fine for low bandwidth consumption, the ever increasing demands on bandwidth render this strategy outdated and inadequate to serve the needs of the modern customer. FTTH easily allows for the bandwidths that modern 'triple play' customers seek, where internet bandwidth, video signals and telephone services are bundled. Additionally, the most advanced technologies are now accessible, including bandwidth intensive items such as gaming, IP camera home video monitoring, video chats, Tele-Med services and internet-based television, sports broadcasts, Smart Home and business energy management technologies.

As an illustration of the ongoing paradigm shift to fiber optics, current DSL and coaxial cable modems to homes permit download speeds of up to about 5 Mbps (with uploading usually being significantly slower) and are struggling to make significant improvements in the technology. However, with FTTH, synchronous speeds of up to 100 Mbps are currently possible and improvements to the electronics are resulting in capacities that are orders of magnitude better, not incrementally. As a result of these advances, fiber optic networks have been called "Future Proof" as a measure of their potential and capability. (Fiber to the Home Council, 2013)

With regard to Hosted IP Voice services, a FTTH enabled home can now enjoy features such as brilliant voice clarity, voicemail messages delivered to email addresses (which will allow the consumer to access them from any internet-enabled computer device or smartphone), find-me-follow-me service (which transfers calls to mobile devices) and features such as call forwarding and call blocking can be administered via a web portal. (Home SC, 2012)

Lastly, with the advances in 'Smart Grid' and 'Smart Home' technologies, the Department of Energy has fully committed to rolling out the installation of devices that communicate with the utility provider,

demonstrating marked improvement in efficiency of both the grid and the end user's home or building. A key feature of the Smart Grid is automation technology enabling the utility to adjust and control each individual device or millions of devices from a central location. Comparable technology has been used for decades in other industries and its acceptance in the modern electrical grid has been assured. Such efficiencies undoubtedly save the end user money and also demonstrate the utility's commitment to responsible and modern energy distribution.

III. Demographics Analysis Overview

Exploration of the Verde Valley's projected future growth

A crucial aspect of the viability of the fiber project is trying to gauge both current and future demand, with population growth being a key component of that aspect. Taking data from the Verde Valley Broadband Preliminary Demand Analysis, we looked at current populations of several communities in the Verde Valley as well as three projections of population growth for Yavapai County.

Demographics

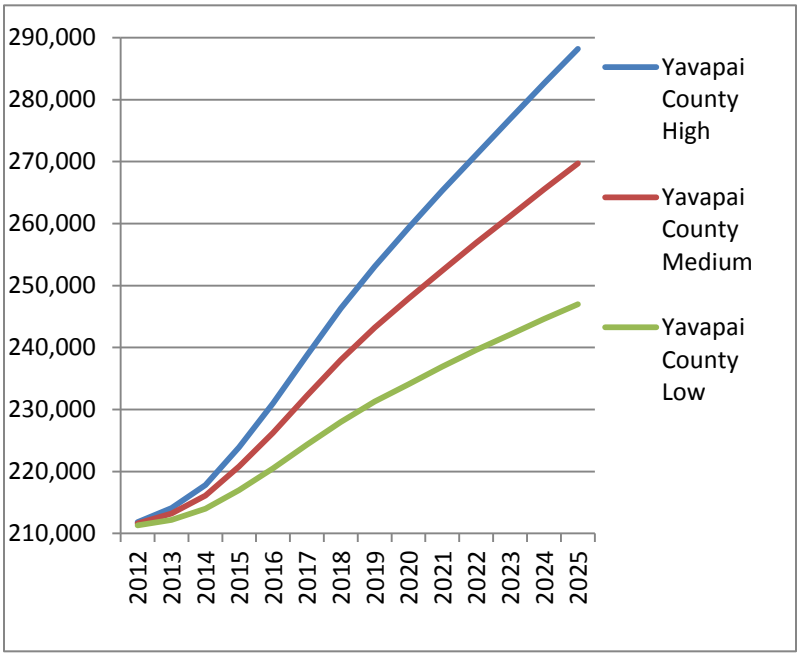
Table 1 Community Income, Population, and Educational Attainment

Verde Valley Cities, Towns, Unincorporated Areas, Native American Tribes	Population 2014	Median Household Income	Average Household Income	Educational Attainment % of Pop. with a bachelors or higher
Camp Verde	11,205	$41,651	$57,623	10.9%
Clarkdale	4,190	$48,883	$63,427	13.5%
Cottonwood Bridgeport	11,542	$41,057	$52,758	11.7%
Jerome	461	$35,600	$56,242	18.9%
Sedona	10,382	$56,579	$116,224	39.3%
Bridgeport	NA			
Cornville Page Springs Verde Santa Fe	3,407	$48,939	$61,635	24.2%
Lake Montezuma McGuireville Rimrock	4,813	$49,850	$57,268	15.1%
Verde Villages	11,907	$49,981	$63,635	13.6%
Village of Oak Creek	6,337	$66,922	$106,767	43.3%
Yavapai-Apache Nation	2,435	$27,600		
Total	66,679			

(Yavapai College Regional Economic Development Center, 2014)

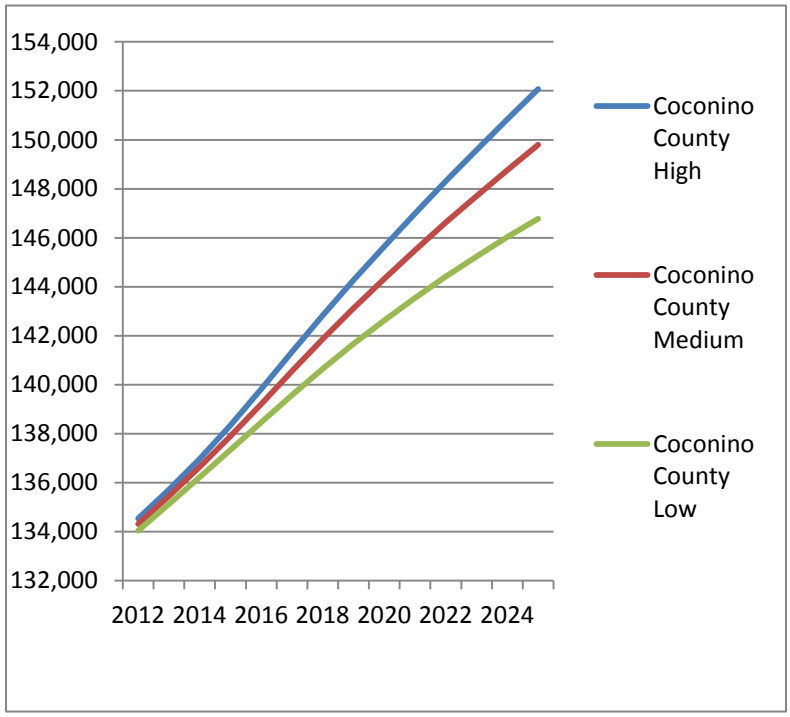
Yavapai and Coconino Population Growth Projections until 2025

Year	Yavapai County High	Yavapai County Medium	Yavapai County Low
2012	211,800	211,600	211,300
2013	214,100	213,200	212,200
2014	217,800	216,100	214,000
2015	223,900	220,800	217,000
2016	231,000	226,200	220,500
2017	238,700	232,200	224,300
2018	246,300	238,000	228,000
2019	253,100	243,200	231,300
2020	259,300	247,900	234,100
2021	265,300	252,400	236,900
2022	271,100	256,900	239,600
2023	276,900	261,200	242,100
2024	282,600	265,500	244,600
2025	288,200	269,700	247,000



(Arizona Department of Administration, 2013)

Year	Coconinco County High	Coconino County Medium	Coconino County Low
2012	134,542	134,313	134,039
2013	135,711	135,446	135,125
2014	136,973	136,636	136,223
2015	138,355	137,903	137,346
2016	139,823	139,219	138,472
2017	141,343	140,558	139,581
2018	142,837	141,867	140,652
2019	144,272	143,121	141,668
2020	145,648	144,320	142,626
2021	146,995	145,486	143,542
2022	148,308	146,617	144,415
2023	149,592	147,711	145,244
2024	150,849	148,771	146,032
2025	152,076	149,794	146,775



Verde Valley Housing and Hotel Room Figures

Table 2 Single Family Housing and Apartments

Camp Verde	4224
Clarkdale	2215
Cottonwood	5677
Jerome	253
Sedona	6780
Cornville	1748
Lake Montezuma	2320
Verde Villages	5388
Village of Oak Creek	4143
Yavapai-Apache Nation	331
Total	33,079

Table 3 Hotel Rooms

Camp Verde	301
Clarkdale	27
Cottonwood	300
Jerome	80
Lake Montezuma	22
Sedona	3000
Yavapai-Apache Nation (including 181 RV slots with WiFi access)	262
Total	3992

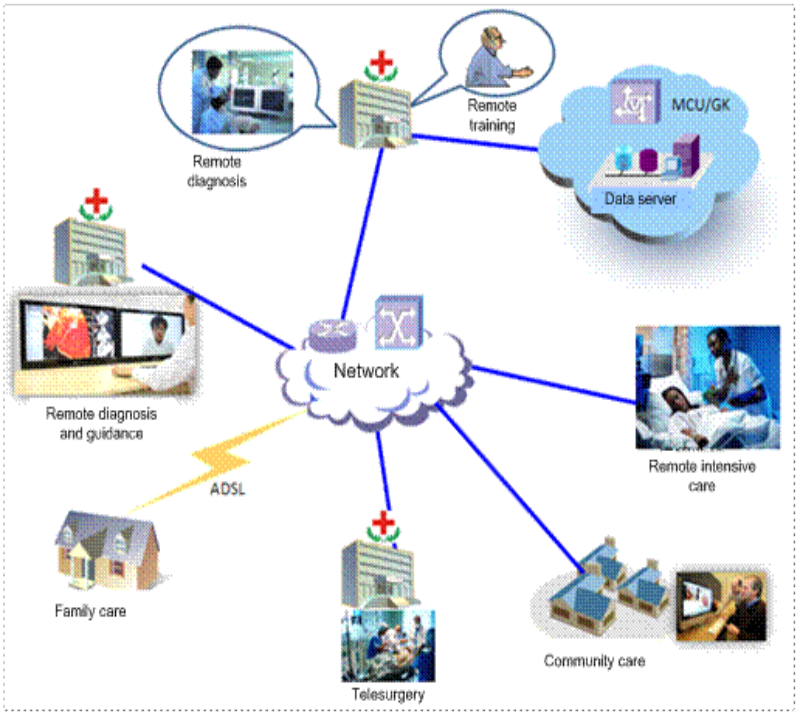
(Yavapai College Regional Economic Development Center, 2014)

America's classrooms are migrating to one-to-one computer programs (also known as "ubiquitous computing"), whereby each student and teacher has one Internet-connected wireless computing device for use both in the classroom and at home. Such connectivity also means that costly and unwieldy printed textbooks can be eliminated, saving districts untold amounts each year, not to mention the ease of annual updates. A 2006 survey found that 31 percent of superintendents are implementing ubiquitous computing in at least one grade, up from an average of 4 percent. Moreover, over 75% of superintendents recognized the potential benefits of one-to-one computing, agreeing with the statement that "ubiquitous technology can reduce the time, distance, and cost of delivering information directly to students and that teachers can spend substantially more one-on-one time with each student and personalize the education experience to each student's needs."

(CTC Technology & Energy, 2014)

Telemedicine

Until recently, telemedicine was viewed as an expensive and unrealistic solution for providing healthcare to a large segment of the population. However, due to advances in smartphone technology and cheaper and more plentiful bandwidth, the Mayo Clinic in Scottsdale and a division of the University of Arizona are concluding that practicing medicine in remote and underserved areas will continue to flourish. As more and more communities are able to access affordable bandwidth, the demand will continue to grow and some physicians see it as the next logical progression. Supplying bandwidth to otherwise underserved areas will bring terrific PR and even more importantly, perhaps lifesaving technology to thousands of people.



(Allen, 2012)

Healthcare Connect Fund

On December 12, 2012 the FCC created the Healthcare Connect Fund (HCCF) to expand access by health care providers to robust broadband networks. Building on lessons learned from 50 pilot projects testing how to most effectively use broadband to improve the quality and reduce costs of health care in rural areas, the HCCF reforms modernize the FCC's existing universal service Rural Health Care Program to expand the benefits of telemedicine nationwide. Stated goals of the program include:

- Increase access to broadband for health care providers (HCPs), especially those serving rural areas
- Foster development and deployment of broadband health care networks
- Maximize cost-effectiveness of the FCC's universal service health care program

Additionally, local residents of rural areas will benefit by having their rural HCPs have access to medical specialists at larger HCPs through telemedicine, have enhanced exchange of electronic health records and coordination of care and improved quality and lower cost of health care.

Finally, the HCCF provides a 65% discount on broadband services, equipment, connections to research and education networks, plus HCP-constructed and owned facilities if shown to be the most cost-

effective option, provided the local HCP supplies the remaining 35%. Very simply put, the program is much like its successful cousin, E-Rate, except that the reimbursement is a flat 65%. The program launched on January 1, 2014 and should be an excellent program for the hospitals and health care facilities in the Verde Valley and could assist in funding and expanding the VVREO Network Vision.

(FCC, 2014)

Arizona Senate Bill (SB) 1402

Colloquially known as the Arizona Digital Highways Bill, Governor Jan Brewer signed SB 1402 in 2012. According to a release by the Arizona Strategic Enterprise Technology Office, "*The Arizona Digital Highways bill establishes a sustainable broadband deployment program that will better enable economic growth, education, public safety, healthcare, and business across Arizona. Private sector providers will now be able to more economically extend broadband services to poorly served rural Arizonians by expanding the use of existing state roadway rights-of-way (ROW). This will be possible without drawing on existing highway or state general funds under the guidance of the Arizona Department of Transportation (ADOT) in partnership with the Arizona Strategic Enterprise Technology (ASET) office in the Department of Administration.*"

Essentially ADOT will now consider the transportation of information along with the movement of vehicles when doing road construction. The bill instructs ADOT to enable installation of multiple empty runs of conduit alongside the state highways when under construction and lease the conduit space back to telecommunication firms on a cost-recovery basis, provided firms have agreed in advance to the lease. The goal of the program is to greatly accelerate the spread of telecommunications to the more rural areas of the state while saving the providers untold millions as compared to the expense of having to secure those state ROWs otherwise. While it is expected to take years, if not decades, for the program to be fully implemented, the fact is that the Verde Valley is in prime position to take advantage of this opportunity sooner rather than later.

(Arizona Strategic Enterprise Technology, 2012)

Explanation of the benefit of Fiber Optic networks and platforms

Prior to the widespread deployment of fiber optics, copper was the medium of choice by which to transmit information. The standard around the world for decades, copper requires pulses of electricity to send information, whereas fiber optics works with pulses of light. Fiber optics are superior to copper for a number of reasons, including the ability to carry information for long distances (thousands of miles) without degradation. In contrast, copper can also carry high bandwidth, but only for short distances, perhaps a few hundred yards after which the signal's fidelity fades. Fiber optics, being glass, are also immune to many issues that plague copper, including corrosion and have an immunity to lightning strikes. Also, a length of fiber optic cable weighs less than a comparable length of copper cable

and is of no value to copper thieves and vandals. Fiber optics has been used to carry transmissions for decades, but in the past, it was primary for long haul runs between cities or countries. Finally, the concept of something being 'Future Proof' is often bandied about, but often with little thought as to what that means. With fiber optics however, the same fiber that can transmit 2 Mbps (a bit more than a T1) can carry up to 40 Gbps (literally 20,000 times as much) with the proper electronics on each end for the signaling. It is because of this type of scale that Fiber has earned the well-deserved reputation as "Future Proof."

Conclusion

As we have compiled our research, analyzed our findings and examined the facts, we feel the Verde Valley Regional Economic Organization's decision to explore a Gigabit Network throughout and connecting the various communities is extraordinary. While there are still unknowns at this juncture, all indications point to a unique business opportunity that effectively leverages current assets and takes advantage of a forward-thinking Senate Bill while resolving underserved communities' digital divide. Once the proper due diligence is complete, detailed engineering plans and pro-forma financial analysis should commence.

We are confident our research and experience has served well in the formulation of this road map for success. Based on our conclusions, we would advocate the build-out of the proposed VVREO Middle Mile Network. The VVREO Wide Area Network WAN would provide an alternate network to the existing carriers in the region, and vital addition to municipalities, school districts and businesses throughout the Verde Valley area as a means to increase their bandwidth and access new products and services via the new, highly reliable second network. Along with VVREO Middle Mile Network, we advocate the simultaneous construction of Metropolitan Area Networks in each municipality, with strategic community breakouts to take advantage of future growth. Additionally, the roll out of Hosted IPBX phones, CoLo, Backup and Disaster Recovery (BDR) services (to name a few), would undoubtedly be attractive features and benefits to those enterprises looking to divest themselves of years of substandard services from the incumbent. Strategic partnerships would and could enable the wave of future services across the VVREO Ethernet network platform.

GSW Telecom & Consulting has the experience and know-how to facilitate and manage the construction and implementation of the proposed networks and we look forward to collaborating and completing the outstanding next steps and phases. Given the wealth of resources, assets and experience available, the evidence demonstrates the proposed Network is positioned for success for the local communities, governments, School districts, universities, businesses and residents of the Verde Valley.

In our expert estimation, it is not a question of whether a fiber network should be built, but rather when!

Respectfully Submitted by:

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Appendix

Funding – Rural Telecommunications Programs

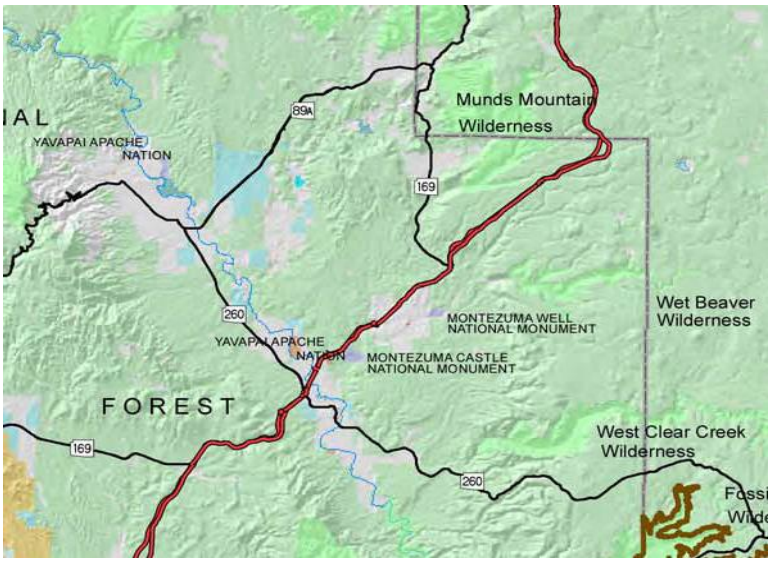
Through our research, we have identified a number of Government-backed programs available to rural communities to help build and expand networks. The United States Department of Agriculture (USDA) has at least four loan and grant programs designed to improve the infrastructure and economic development in sparsely-populated regions, with telecom qualifying as one of the targeted areas. In fact, more than $22 billion has been invested in rural America since 1949. Below is a snapshot of the noteworthy and current programs that will come into play.

- **Telecommunications Infrastructure Loan Program** — Loans to improve and build telecommunications service in service in rural communities (<5,000 population)
- **Rural Broadband Loan Program (Farm Bill)** – Loans to build and upgrade broadband services in rural high cost areas (<20,000 population)
- **Communication Connect Grant Program** – Grants for broadband service providers and others who offer broadband services in rural and remote areas (<20,000 population)
- **Distance Learning/Telemedicine Loan and Grant Program** – Loans and grants for providing Distance Learning and Telemedicine services to rural residents and anchor institutions

(USDA, 2013)

Solar and Wind Power Generation Projects and Network Connectivity

According to the Bureau of Land Management, while there are a number of solar (8) and wind power generating applications (6) in various stages of submission in Arizona as of August 2013, none are within 100 miles of the Verde Valley. (A full reproduction of the map can be found on the following page, but a closer look at the Verde Valley is included here.) In the event that a utility does ultimately construct a solar or wind generation plant in the region, a fiber connection to monitor operations would be a crucial connection for SCADA purposes.



(US Dept of the Interior, 2013)

Current Solar/Wind Projects, Approved or Pending

Solar Applications

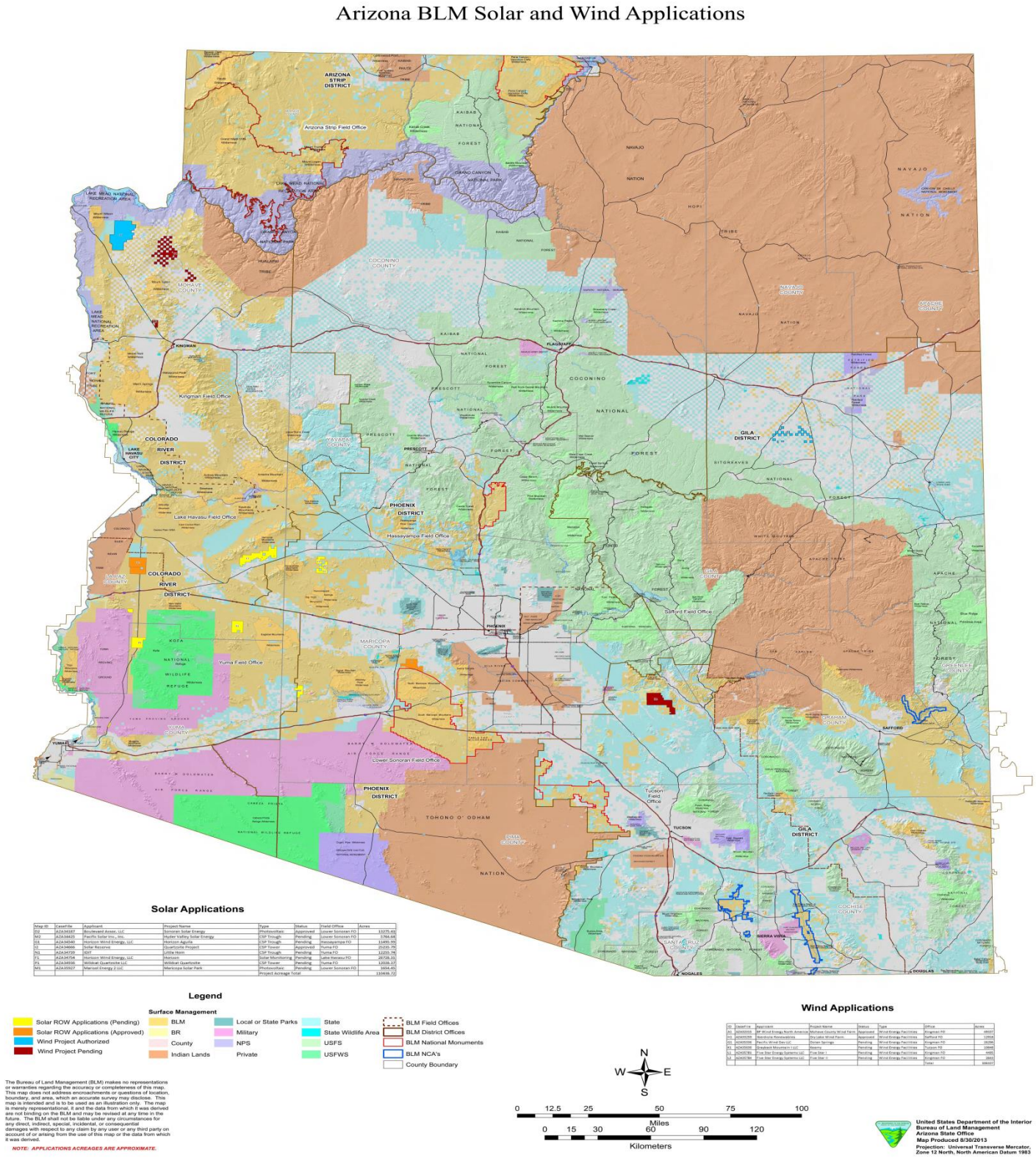
MAP ID	Applicant	Project Name	Type	Status	Acres
D2	Boulevard Assoc LLC	Sonoran Solar Energy	Photovoltaic	Approved	13275
M2	Pacific Solar Inv., Inc	Hyder Valley Solar Energy	CSP Trough	Pending	5765
G1	Horizon Wind Energy LLC	Horizon Aguila	CSP Trough	Pending	11496
I2	Solar Reserve	Quartzsite Project	CSP Trough	Approved	25236
N1	IDIT	Little Horn	CSP Trough	Pending	12256
F1	Horizon Wind Energy LLC	Horizon	Solar Monitoring	Pending	28728
P1	Wildcat Quartzsite LLC	Wildcat Quartzsite	CSP Trough	Pending	12028
M1	Marisol Energy 2 LLC	Maricopa Solar Park	Photovoltaic	Pending	1654
					110438

Wind Applications

MAP ID	Applicant	Project Name	Type	Status	Acres
A1	BP Wind Energy North America	Mohave Co. Wind Farm	Wind Energy Facil.	Approved	49107
H1	Iberdroia Renewables	Dry Lake Wind Farm	Wind Energy Facil.	Approved	12918
G1	Pacific Wind Dev LLC	Dolan Springs	Wind Energy Facil.	Pending	26296
K1	Grayback Mountain I LLC	Kearney	Wind Energy Facil.	Pending	10648
L1	Five Star Energy Systems LLC	Five Star I	Wind Energy Facil.	Pending	4495
L2	Five Star Energy Systems LLC	Five Star II	Wind Energy Facil.	Pending	2643
					106107

(US Dept of the Interior, 2013)

Arizona BLM Solar and Wind Applications Full Map



Mileage Chart

Mileage	Camp Verde	Verde Village	Cottonwood	Clarkdale	Jerome	Sedona
Camp Verde	--	13.6	16.1	20.2	23.9	35.1
Verde Village	13.6	--	3.5	6.6	10.3	20.0
Cottonwood	16.1	3.5	--	4.0	9.3	19.0
Clarkdale	20.2	6.6	4.0	--	5.2	23.0
Jerome	23.9	10.3	9.3	5.2	--	28.0
Sedona	35.1	20.0	19.0	23.0	28.0	--

Note that distances are per Google Earth and are to be used as general estimates only. Also, Camp Verde to Sedona mileage is through Verde Valley, not IH-17.

(Google Earth)

Current Broadband Options in Verde Valley

Camp Verde — Total is 15, excluding 4 Satellite options

Advertised Upload (Mbps)	Advertised Download (Mbps) 0.2 - 0.768	0.768 -1.5	1.5 - 3	3 - 6	6 -10	10 - 25	25 - 50	50 - 100	>1000
0.2 - 0.768	Suddenlink	Sprint, Verizon	Suddenlink						
0.768 -1.5		CommSpeed	ATT	CLink	CLink	CLink Suddenlink	Suddenlink		
1.5 - 3				ATT					
3 - 6						ATT, Verizon		Suddenlink	
6 -10									
10 - 25									
25 - 50									
50 - 100									
>1000									

Cottonwood — Total is 23, excluding 4 Satellite options

Advertised Upload (Mbps)	Advertised Download (Mbps) 0.2 - 0.768	0.768 -1.5	1.5 - 3	3 - 6	6 -10	10 - 25	25 - 50	50 - 100	>1000
0.2 - 0.768	Verizon	Sprint	Suddenlink T-Mobile	CLink					
0.768 -1.5		CommSpeed	CLink ATT	CLink	CLink	CLink Suddenlink			
1.5 - 3			CLink	eSedona, ATT	T-Mobile	Suddenlink		CableOne	
3 - 6						ATT, Verizon	CLink		
6 -10						T-Mobile			
10 - 25							CLink		
25 - 50									
50 - 100									
>1000									

Clarkdale — Total is 16, excluding 4 Satellite options

Advertised Upload (Mbps)	Advertised Download (Mbps) 0.2 - 0.768	0.768 -1.5	1.5 - 3	3 - 6	6 -10	10 - 25	25 - 50	50 - 100	>1000
0.2 - 0.768		Sprint, Verizon		CLink					
0.768 -1.5		CommSpeed	CLink ATT		CLink	CLink			
1.5 - 3				ATT	eSedona			CableOne	
3 - 6						ATT, Verizon	CLink		
6 -10						T-Mobile			
10 - 25							CLink		
25 - 50									
50 - 100									
>1000									

Key:

Cable	
Wireless	
DSL	

Jerome Total is 15, excluding 4 Satellite options

Advertised Upload (Mbps)	**Advertised Download (Mbps)**								
	0.2 - 0.768	0.768 -1.5	1.5 - 3	3 - 6	6 -10	10 - 25	25 - 50	50 - 100	>1000
0.2 - 0.768		Sprint, Verizon							
0.768 -1.5		CommSpeed	ATT, T-Mobile			CLink			
1.5 - 3				ATT	eSedona, T-Mobile			Cable One	
3 - 6						ATT, Verizon	CLink		
6 -10						T-Mobile			
10 - 25							CLink		
25 - 50									
50 - 100									
>1000									

Sedona Total is 23, excluding 4 Satellite options

Advertised Upload (Mbps)	**Advertised Download (Mbps)**								
	0.2 - 0.768	0.768 -1.5	1.5 - 3	3 - 6	6 -10	10 - 25	25 - 50	50 - 100	>1000
0.2 - 0.768		Sprint, Verizon	Suddenlink T-Mobile	Suddenlink CLink					
0.768 -1.5		CommSpeed	CLink ATT	CLink	CLink	CLink			
1.5 - 3				ATT	eSedona, T-Mobile	Suddenlink	Suddenlink	Suddenlink	
3 - 6						ATT, Verizon	CLink		
6 -10						T-Mobile			
10 - 25							CLink		
25 - 50									
50 - 100									
>1000									

Key:

Cable	
Wireless	
DSL	

(State of Arizona, 2014)

"Future-Proofing Your New Building" Article

"Future-Proofing" Your New Building

TREND report

Les Smith and Andy Wieser • published in the July 2013 issue

With the advent and adoption of The Cloud, Software-as-a-Service (SaaS), Web 2.0 and Mobility, the need for reliable and scalable telecommunications has never been more evident. Yet one of the most crucial decisions that a developer can implement in the construction or remodel of commercial buildings, business and research parks to ensure network reliability for tenants and owners is often overlooked and undervalued, that of a proper ingress for a second telecommunications carrier or provider. While it's true that a single, dedicated conduit for voice and data services has long been a part of modern building standards, lately the most forward-thinking developers have been instituting a second, diverse conduit path solely for a separate and redundant telecom connection. Dual Entrance, as the term is known, generally specifies that conduit paths are at least 50 feet apart, if not more. This Dual Entrance conduit, consisting essentially of piping costing pennies per foot, is the ultimate insurance, likely saving tens of thousands of dollars in lost data and business productivity over the life of the structure if installed during construction and coupled with a secondary carrier. Despite this astronomical ROI however, all too often the blueprints are delivered with nary a thought to this potentially enterprise-saving lifeline.

A vital trend and valued requirement of a Business Continuity (BC) Plan is to have a Comprehensive BDR (Backup and Disaster Recovery) Implementation Strategy that includes Dual Entrance. While the Fortune 500 have long realized the value and necessity of these BC/BDR plans, even small and medium entities are becoming highly aware of the damage that an errant backhoe shovel, vandal's mischief or monsoon storm's havoc can cause on an unprepared firm's telecommunications, productivity and profits. This problem of losing connectivity with a single carrier providing services is compounded with the rise of Cloud-based services, Hosted Voice over IP phones and computer applications that rely on internet connections. The carrier's line, when severed, can mean that both voice and data are down.

Additionally, as the Federal Government implements its stated goal of a National Health Information Infrastructure (NHII), compliance with patient record security and accessibility criteria set by the Department of Health and Human Services will likely become the de facto minimum standards used by all related healthcare, pharmaceutical and bioscience firms. In fact, the most secure firms, including those adhering to HIPAA guidelines, have or are considering primary or backup Data Centers at least 50 miles away from the office and have a high reliance on internet and cloud-based applications. The new criteria all lend credence to the wisdom and evolving requirement for Dual Entrance, Dual Carrier solutions.

It is important to note that with the slow, but steadily improving local and regional business climate, a number of affordable options exist for the secondary carrier. While Ethernet over Fiber Optics ("Fiber") is considered the gold standard technically in terms of its Synchronous performance, low latency, minimal packet loss and jitter, it is also usually more expensive. For example, whereas

defense contractors, military bases and hospitals may generally require Dual Fiber/Dual Entrance connections, a typical firm looking to protect itself from catastrophic loss or interruption of service may deploy the more economical broadband options supplied by a telecom or cable television providers such as DSL or cable modem services. These carrier and cable options may not offer as technically reliable of an SLA (Service Level Agreement) as a Fiber-based solution, but like a second parachute when skydiving, it's always better to have and not need it than need something and not have it.

Tucson's affordability, climate, position as a transportation logistics hub and reputation as a cradle of Bioscience, Medical, Defense and Optics firms (numbering 160+) will continue to draw attention from companies worldwide. Along with the growth of Oro Valley's Innovation Park, Raytheon and TIA's pending expansion plans, the eventual 2500-acre Aerospace and Defense Research Business Park are key Economic Development Plans along Interstates 10 to Phoenix and 19 to Nogales and the proposed Pima County portion of Interstate 11. This highway confluence (known as the Canamex Corridor) and expansion of the Port of Tucson Rail and Trucking facilities, coupled with significant storage capacity to stage and manage cost effective logistics, ensures easy access from Tucson to shipping ports in Guaymas, Sonora and Southern California. This balanced network all but guarantees that there are going to be companies looking at relocating or expanding to the Tucson area for decades to come. Of course, existing buildings can always be retrofitted with this Second Path to the Demarc, but cutting pavement, boring through walls and foundations, uprooting landscaping and disrupting current tenants is expensive. Enlisting expert opinions and having "Cloud Ready" commercial spaces available for potential clients and tenants from the onset will make the difference between executing an agreement or not.

Taking the idea of accessibility one step farther, brokers and investors may also want to incorporate the idea of "campus conduit" and Dual Entrance with any multi-building complexes being conceived. The idea here is similar, but generally forms a ring-and-spoke type setup if the developer has the opportunity to work on an entire parcel of land. This redundancy and ease of 'pulling fiber' further enforces the idea that a company's communications and data are secure and greatly eases expansion questions when a growing firm is eyeing a second space in the business park.

Access through a building's Dual Entrance conduit enables an array of multiple carriers, offsite data centers and SaaS admin applications that are cornerstones for Mission Critical. One more reason to "Future Proof" Southern Arizona's buildings may be Google Gigabit Fiber, a project to build an infrastructure using Fiber Optics. While Google has not yet indicated any plans to expand to Tucson, recently announced cities like Austin, Texas and Provo, Utah are also mid-sized Western US Cities with a high-profile university identity and perhaps put The Old Pueblo into strong consideration. To accelerate Southern Arizona's business growth, the future demands multiple, scalable and high capacity networks serviced by many carriers. Effectively and technically-designed networks, BC/BDR tactics, strategies coupled with Dual Entrance buildings and knowledgeable, experienced firms like GSW Telecom & Consulting can ensure that your building, business park and company are "Future Proofed."

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Definitions

1U A rack unit, U or RU, is a unit of measure that describes the height of equipment designed to mount in a 19-inch rack or a 23-inch rack. The 19-inch (482.6 mm) or 23-inch (584.2 mm) dimension refers to the width of the equipment mounting frame in the rack including the frame; the width of the equipment that can be mounted inside the rack is less. One rack unit is 1.75 inches (44.45 mm) high.

BDR Backup and Disaster Recovery is the process, policies and procedures that are related to preparing for recovery or continuation of technology infrastructure which are vital to an organization after a natural or human-induced disaster.

BC Business Continuity are preparatory and related activities which are intended to ensure that an organization's critical business functions will either continue to operate despite serious incidents or disasters that might otherwise have interrupted them.

Carrier Neutral Location (CNL) A CNL is a data center (or carrier hotel/CoLo) which allows interconnection between multiple telecommunication carriers and/or Colocation providers.

Central Office (CO) A CO is typically a building used to house the inside plant equipment of potentially several telephone exchanges, each serving a certain geographical exchange area.

CLEC Competitive Local Exchange Carrier, a firm that competes with the area phone company (LEC). Compare to LEC below.

Cloud Computing Cloud computing is a phrase used to describe a variety of computing concepts that involve a large number of computers connected through a real-time communication network such as the Internet. In science, cloud computing is a synonym for distributed computing over a network, and means the ability to run a program or application on many connected computers at the same time. The phrase also more commonly refers to network-based services, which appear to be provided by real server hardware, and are in fact served up by virtual hardware, simulated by software running on one or more real machines.

Colocation (CoLo) A CoLo is a facility where equipment, space, and bandwidth are available for rental to retail customers. Colocation facilities provide space, power, cooling, and physical security for the server, storage, and networking equipment of other firms and connect them to a variety of telecommunications and network service providers with a minimum of cost and complexity.

Dark Fiber Dark Fiber is an unused optical fiber, available for use in fiber-optic communication. Originally used when referring to the potential network capacity of telecommunication infrastructure, it now also refers to the increasingly common practice of leasing fiber optic cables from a network service provider, or generally, to the fiber installations not owned or controlled by traditional carriers.

Data Center A Data Center is a facility used to house computer systems and associated components, such as telecommunications and storage systems. They generally include redundant or backup power supplies, redundant data communications connections, environmental controls (e.g., air conditioning, fire suppression) and security devices. Large data centers are industrial scale operations using scores, if not hundreds, of megawatts of electricity.

Inside Plant The cabling and equipment installed in a telecommunications facility, including the main distribution frame (MDF) and all the equipment extending inward therefrom.

IRU A contractual agreement between the operators of a communications cable, such as a fiber optic network and a client.

Last Mile The Last Mile is a phrase used by the telecommunications, cable television and internet industries to refer to the final leg of the telecommunications networks delivering communications connectivity to retail customers, the part that actually reaches the customer.

LEC Short for Local Exchange Carrier, the local telephone company. Compare to CLEC above.

Meet Me Points Places within a Colocation center (or carrier hotel) where telecommunications companies can physically connect to one another and exchange data without incurring local loop fees

Metro Area Network (MAN) A Metropolitan Area Network (MAN) is a large computer network that spans a metropolitan area or campus. Its geographic scope falls between a WAN and LAN. MANs provide Internet connectivity for LANs in a metropolitan region, and connect them to wider area networks like the Internet.

Middle Mile Middle Mile is the segment of a telecommunications network linking a network operator's core network to the local network plant, typically situated in the incumbent Telco's central office ('CO') that provides access to the local loop. For this project, the Middle Mile Network is a WAN.

Outside Plant (OSP) Refers to all of the physical cabling and supporting infrastructure (such as conduit, cabinets, tower or poles), and any associated hardware (such as repeaters) located between a demarcation point in a switching facility and a demarcation point in another switching center or customer premises.

SCADA Short for Supervisory Control and Data Acquisition, SCADA technology allows firms to monitor, operate and communicate with equipment remotely.

Smart Grid A modernized electrical grid that uses information and communications technology to gather and act on information, such as information about the behaviors of suppliers and consumers, in an automated fashion to improve the efficiency, reliability, economics, and sustainability of the production and distribution of electricity.

Wide Area Network (WAN) A wide area network (WAN) is a network that covers a broad area (i.e., any telecommunications network that links across metropolitan, regional, national or international boundaries) using leased telecommunication lines.

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